# Factors Influencing Pervasiveness of Organisational Business Intelligence

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***Abstract*—Organisations can derive great value from the effective use of business intelligence (BI). The pervasive use of BI can help improve decision making by providing business users with relevant information, which will ultimately lead to better organisational performance and efficiency. However, organisations still struggle to derive the full benefits BI has to offer. The purpose of this study is to gain deeper insight into the factors that influence pervasiveness of BI, specifically in South African organisations. This is an inductive, exploratory study with data collected through semi-structured interviews across various industries. Thematic analysis was used in order to determine the main factors contributing to the pervasiveness of BI in the participating organisations. The major themes that emerged included executive buy-in, strong business focus and ownership, perceived value, education, communication and support. An incremental, phased approach when implementing BI and information quality were also prominent themes. These diffusion factors that promote or impede pervasive BI in the organisation are also discussed through the three contexts of the Technology-Organisation-Environment (TOE) framework. The Organisational context was found to be the strongest influencer of BI pervasiveness in these organisations.**

***Keywords-business intelligence; pervasive; diffusion; TOE framework.***

## I. INTRODUCTION

For the last four years, business intelligence (BI) has been rated as the number one "*application and technology development investment*" [1], having been in the top three every year since 2003. Various leading international consultancies give it similar prominence. Why does BI continue to retain this top rating? Why have companies not completed their BI implementations (as with, e.g., ERP), and moved on to other "*key issues*"? It is clear that many BI implementations are incomplete or unsuccessful, and can only be regarded as delivering full value when BI is pervasive in their organisations. This research explores the BI experiences of a number of South African organisations that have travelled far along the BI road, in order to uncover the key factors that have made BI pervasive there.

The paper first gives some limited background to aspects of the BI area, then explains the research methodology adopted. Interview data is then analysed to obtain key factors of pervasive BI. This is further discussed with reference to the technology-organisation-environment (TOE) framework and other literature, and the paper then concludes.

## II. BACKGROUND

Business Intelligence is a collective term describing the business systems and applications that organisations use to support their decision making processes. Through the use of information technology, BI allows organisations to gather, store, analyse and disseminate large volumes of data, in order to make better and more informed business decisions [2][3]. More concisely, "*business intelligence systems provide actionable information and knowledge at the right time, in the right location, and in the right form*" [4, p .176].

Although the first use of the term "Business Intelligence" is generally attributed to Howard Dresner of Gartner in 1989, H.P. Luhn published the article "*A business intelligence system*" in a 1958 IBM journal [5]. Since that early era of IT, business intelligence has evolved in many forms. Academically the "*umbrella term*" has until recently generally been decision support systems (DSS), but lately academia has also adopted the term BI used by industry.

Space limitations do not permit a detailed review of the styles and functional components of BI. A good summary is given in [6]. Usage of BI may be classified as enterprise vs departmental BI [7] and operational vs tactical and strategic BI [8]. Recently there has been a move to real-time or right-time BI [4][9]. BI technologies may be divided, e.g., into back-end and front-end [10] or technologies enabling (respectively) organisational memory; information integration; insights and decisions; and presentation [11].

The main back-end components are the data warehouse and data extraction, transformation and loading (ETL) systems that populate it [7][12]. BI front-end components comprise tools used by business users to interrogate the data stored in the data warehouse. The most commonly used tools enable ad hoc querying, reporting and analysis. Other front-end tool sets offer the following functionalities: Online analytical processing (OLAP); Dashboarding and scorecarding; Performance management; Predictive analytics and data mining; Alerts and notifications; BI portal and MS Excel integration [2][6][7][11][13].

### *Pervasive Business Intelligence*

Given lack of a consistent definition of pervasive BI in the literature, the following is given: Pervasive BI is the ability to deliver the right information at the right time to business users across all levels of the organization, in order to make better decisions in all processes at all times. It provides users in different functional areas with the necessary visibility into their key business metrics, as defined by their strategic objectives, whilst providing insight

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and understanding into how it impacts on the organisation as a whole [9][14][15].

The value of pervasive BI lies in its ability to create performance transparency in the organisation through clear and consistent communication of management's strategic objectives. Insight into the organisation's key performance indicators (KPI's) allows managers to react in a timely manner to opportunities or issues that may occur, thus creating a competitive advantage [14]. Value also lies in the improvement of key business processes [15] and improved information quality [10], time and cost savings through automated delivery of information to users, and reduced IT infrastructure costs due to optimised storage and processing of data [9]. Often these benefits are not clear to business executives as they are intangible and therefore difficult to measure [3].

## III. RESEARCH METHODOLOGY

The objective of the research is to determine factors that can assist organisations to be more successful in achieving pervasive use of BI. This led to the following research questions:

- What are the main factors influencing pervasive BI?
- How do these factors fit into a TOE framework?

### A. Research Purpose, Philosophy and Approach

The underlying philosophy of this exploratory research was interpretivism, as it aimed to gain a deeper understanding of factors influencing the pervasive use of BI within South African organisations, based on the experiences and organisational contexts of the participants [16][17]. The qualitative data provided the researchers with rich, descriptive responses that facilitated in-depth understanding, and the approach was inductive as the researchers populated the TOE framework with the factors that emerged from the data collected. The research timeframe was cross-sectional.

### B. Research Sample

To gain good insight into pervasive use of BI (not merely adoption), it was important to obtain data from organisations with an established BI programme. The researchers used purposive sampling to choose five large organisations from different industries (including retail, insurance, telecommunications and health services) with mature BI programmes established between nine and 15 years ago. The decision was made to involve fewer organisations in order to be able to interview multiple people within each organisation, and gain multiple perspectives regarding each organisation's BI programme. The researchers conducted interviews with eleven participants who all had a very good understanding and substantial experience of BI. They included users at executive, tactical and operational levels, as well as BI practitioners who had implemented BI solutions.

### C. Data Collection and Analysis

Semi-structured qualitative interviews comprised of open-ended questions allowed the researchers to ask additional questions based on the interviewee's responses, and to enable the interviewees to elaborate further on their responses [17]. The list of interview questions was derived from related BI literature, and an interview protocol served as a guideline to ensure all issues were covered. This comprised areas such as: reliance on BI in decision-making, degree of internal use, degree of information sharing, degree of external use, degree of information integration, number of subject areas in data warehouse, data latency, BI alignment to corporate strategy, governance, influence of BI on users' actions, and vendor knowledge and support. Interviews of 60 minutes plus were conducted at the interviewees' premises.

TABLE I. CODING EXTRACTS

| Code | Participant | Data Extract |
|---|---|---|
| **Education and support**<br><br>**Business Ownership** | PG | I think that other key thing that we did was, we gave the ownership of training to the business. So those business champions that owned BI in the various business units also make sure that they had a group of people there that would provide training on the tool. |
| **Incremental approach** | PA | starting small, and delivering something and actually showing people the benefit and then getting momentum or gaining momentum from there is the way to go. If we'd gone Big Bang, nobody would've signed the check; I mean there's not a chance. |

Thematic analysis and coding were used to uncover themes and patterns in the data [18][19]. This inductive approach allowed for "*research findings to emerge from the frequent, dominant or significant themes inherent in the raw data, without the restraints imposed by structured methodologies*" [19, p. 238]. Table I provides an example of related codes for data extracts from two of the participants (who were given labels from PA to PK).

The resulting pervasiveness factors were also viewed through the lens of Tornatsky and Fleischer's Technology-Organisation-Environment (TOE) framework [20] – chosen as it is broad and does not impose restrictions on the possible diffusion factors that might have emerged during analysis. Two widely used models for adoption, assimilation and diffusion at the firm (as opposed to individual) level are the TOE framework and Rogers' Diffusion of Innovation Theory (DOI) [21]. The TOE framework identifies three aspects of an enterprise's context that influence the process by which it adopts and implements a technological innovation: technological context, organizational context, and environmental context (this aspect not included in the DOI theory). These three elements present "both constraints and opportunities for technological innovation" [20, p. 154]. The TOE framework has a solid theoretical basis, consistent empirical support, and has been used for adoption and diffusion of amongst others: EDI, open systems, websites, E-commerce, the Internet, ERP, e-business, and knowledge management systems [22].

### D. Other Aspects

To establish validity the researchers clearly described the data collection and analysis processes; and categorisation

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and coding of data was carefully documented. All data was collected from credible sources involving experienced people from industry. Due to the purposive sampling technique and sample size the study's findings cannot be generalized or considered representative of all South African organisations, but rather give insight into the phenomenon of pervasive BI. Participation in the interviews was voluntary, approval was obtained from the respective organisations, and full confidentiality was observed.

## IV. DATA ANALYSIS

During the data analysis process, five major themes emerged: senior executive buy-in; business involvement and ownership; education and support; the importance of an incremental, phased approach; and information quality, form and availability. Each of these represents multifaceted aspects, so despite limited space a few examples are given of sub-themes to ensure most are represented. Some minor themes also emerged as possible influencers of pervasive BI within the participating organisations. These themes were not common across all participating organisations, but are included to ensure a holistic analysis. Interview participants will be referred to as PA, PB, .., PK.

### A. Senior Executive Buy-In and Involvement

A prominent theme is top executive buy-in. All participants confirmed senior executive support and involvement as critical to success of any BI implementation. PA, an experienced BI manager of a large insurance company, stated "*one of the main, main, main things is getting top management buy-in. Without that you are sunk*". PI, a retail BI manager, suggests that "*BI needs to be changed from top down. You shouldn't grow it bottom up*". PG, another retail BI manager, says "*Try at the most senior level - I don't think you'll always get it at CEO level - but certainly at the executive committee level.*"

#### 1) Executives' perception of BI

PJ, manager of the enterprise data warehouse (EDW) in a telecommunications company, states that executives are "*taking information for granted; they don't realise that you have to put in a lot to get valuable information out*". PG describes the perception of executives in his organisation as follows: "*I think they perceived it to be of value, but they also had a perception that BI didn't deliver. And I think that's because, especially in the legacy environment, it took very, very long for things to get done*."

#### 2) Obtaining executive buy-in

PA mentions they "*decided to basically give him* [CEO] *something first, even though from a business perspective it wasn't probably the biggest value add, but it's scored a lot of executive points.*" PG stresses the CEO-CIO link: "*Our CEO and CIO had a very close relationship, broader than just BI, I think the CEO got a greater appreciation of how IT can provide business advantage, and I think they saw BI as one of those key strategic types to enable that.*"

#### 3) Executives' active use of BI

In almost all cases participants reported limited usage and involvement by senior executives. PA suggested: "*I don't think an executive is going to use BI as much necessarily as somebody at an operational level. But they could use one piece of information, once a year and make a critical decision that impacts the whole business.*" Executives will generally rely on the next layer of management to actively use the information and they only want to "*be fed back summaries or be notified of decisions, they don't want the blow-by-blow of what's happening"*.

### B. Strong Business Focus and Ownership

In all instances participants recommended that the main focus should be on the needs of the business, who should take ownership of the BI programme. "*You should have your most influential and most relevant executives across the business stipulate what their requirements are ..... and when BI meets that requirement everything else will follow*" (PI). PK, a senior IT executive in health services noted that their BI "*was more an IT initiative*", but despite that, they would not develop or implement anything without "*full sponsorship and ownership from that business discipline*."

#### 1) Establish business ownership

Business should drive and own the decisions made in terms of the organisation's BI strategy and initiatives. "*The business owns the information, so there's no decision making or sign-off of a solution without business buy-in*" (PI). PG suggests that key individuals should be identified in the business, but with executive sponsorship: "*While there was senior executive sponsorship, there were key senior managers or executives in the business that owned BI for that business unit.*"

#### 2) Obtaining business buy-in

Establishing business ownership requires business buy-in, an important facilitator of pervasive BI. Ideally a BI programme should be initiated from the business side, but participants' BI programmes originated as both business and IT initiatives. One organisation's participants clearly stated it was an IT initiative, whereas PA stated: "*They came to us and said 'We need BI'. So that's a whole different ballgame, they were kind of sold up front*". PG recommends approaching business users "*seen as business process champions*" who "[understand] *the business process*" and ideally "[understand] *a little bit about IT*".

#### 3) Understand business need

All participants agree that a good understanding of business requirements and how business wants to use the information is essential to ensure BI delivers business value. The insurance organisation identified business champions, and makes "*Subject Matter Experts*", available to the BI business analysts (PB). The telecommunications company developed a "*BI SDLC*", featuring much "*prototyping with the users*" (PE), and gets the true business users involved as early as possible. The retail organisation focuses strongly on self-service BI, equipping business users with the flexibility and tools to explore their own data and through a prototyping approach express their information requirements (PG).

### C. Education, Communication and Support

These appear to be strong influencers of pervasiveness of BI. All organisations had invested much resource and effort

to establish a dedicated training and support programme for business users. These programmes educated and supported users not only in the use of the tool, but on the information itself and how to interpret and use it in daily decision making activities. Most participants agreed that education in the interpretation and application of the information was much more critical to the pervasiveness of BI than the features and functions of the tool. PI stated: "*quite frankly, without that* [training and support], *they wouldn't get half the value they get from BI*", and PA noted: "*I also think the whole education, training, support and communication side of things is absolutely vital……. Because that is what I really believe is the key to really pervasive BI*."

*1) Education and Training*

Four of the organisations reported that business users often struggle to use information correctly in their decision making activities. PE found that "*they could be pulling dimensions around and having great fun with the tool, in a sense, but they're doing it for the wrong reasons…they're not thinking beyond the use of the tool*". PC describes training as "*a slow and ongoing process*" that requires patience and perseverance, adding that "*you can't repeat it enough*". Multiple training methods were used to accommodate different types of users. PJ suggests a mixed training session, with a group session in the morning and one-on-one sessions in the afternoon. "*A lot of the executive training was one-on-one*". PD believes that one-on-one training sessions are more effective as "*there's too much internal competition sometimes*" and "*they are more likely to clam up*". In some instances business users "*outsourced*" training to their personal assistants.

*2) Communication and marketing*

Three organisations reported having dedicated BI marketing and communication resources and processes: "*the more effective you can be in telling people what is happening, branding it, and really making it part of the business, is absolutely key*" (PA). Regular update sessions communicate changes and improvements to the system, with group sessions or electronic newsletters for more complex changes (PH).

*3) Support*

Business users also need dedicated channels to provide feedback and ask questions if they are unable to locate or interpret information. All organisations provided support mechanisms for their respective business communities, that assist business users with both tool and business related queries. PC commented that educating, mentoring and encouraging business users require a lot of patience and perseverance. PD noted the challenge in finding the right type of person: "*there have been very few that are well cut out that can be working as trainers, mentors, general support; and general communication, marketing all together - effectively rolled into one*".

### *D. Incremental, Phased Approach*

All participants agreed that the best approach is to establish a solid, overall architecture and design, then proceed to incrementally build sections of it; preferably focusing first on areas that will add most value to the business. Continuously delivering business value was a recurring theme in interviews. "*You have to be selling it purely on what is the incremental value you're giving each step of the way and you build it up and you make sure that you've got the capabilities when you need them*" (PD). PA concurs, saying "*incremental delivery is much more attractive to the business*". Benefits of BI are not always tangible and make it difficult to quantify ROI. An incremental approach that continuously delivers value to the business helps address this challenge. PD comments that "*delivery must really be on a small, manageable topic that you can deliver in six months. Max!*", whereas PA suggests "*nothing longer than three month increments*". PG describes their delivery cycles as a staggered approach with some overlapping of phases, with each phase between six and eight months.

### *E. Information Quality, Format and Availability*

BI provides value when it delivers the right information, at the right time and in the right format. But challenges are that users at different levels in the organisation need information at different levels of detail at different time intervals, and people have different preferences of format, display and interaction. These challenges were expressed in nine of the interviews.

*1) The need for a data warehouse*

All participants expressed the importance of a data warehouse for large scale deployment of BI. PG states: "*I think that is the foundation and cornerstone*". Three organisations have an EDW in place that supported reporting across multiple business processes. The other two had a data warehouse per company, but it was not fully consolidated, as the diverse business streams of the respective companies in the group did not warrant this. PA explains "*it depends on how much commonality there is between the various business units and how much opportunity there is for sharing, from a data and from an information perspective*".

*2) The right level and format of information*

PD suggests that organisations should look critically at what they are trying to measure and decide "*at what level is it useful and when does it become true, but useless*". Another challenge is that business users don't always know what information they need, or struggle to define accurate measures that will be useful in monitoring their business. The format the information was delivered in also influenced whether business users made use of the information. "*You must identify the various users and have various presentation methods for the various groups of users. I think that is the key*", comments PJ.

*3) Data quality and availability*

Data quality and consistent delivery of accurate data were stated to be important factors. "*Source the data in a timeous fashion, and make it available, accurately, to the user*", mentions PH. PB comments that it is important for users to trust the information: "*as soon as they don't trust the information then whatever you've done is gone*", but PE notes: "*I don't know if the data governance part is really appreciated on an executive level*".

### F. Perceived Value

Value is a frequently recurring factor threading across the themes discussed in this section. Participants used the term "*value*" repeatedly in their discussions around business focus, education, data quality and using a phased approach, e.g., "*You have to be selling it purely on what is the incremental value you're giving each step of the way*" (PD), and "*Start off by showing value first*" (PB).

### G. Minor Themes

In addition to the major themes discussed so far, some minor themes emerged that also play a role in the organisations' drive for pervasive BI.

#### 1) Vendor involvement

Participants felt it important to have a close working relationship with the BI vendor(s), as BI is a long-term project. PG explains: "*There's a road you need to walk with BI, it's not something that evolves in any organisation overnight, and that's why you need to pick those strategic partners*". However PA said: "*I think that companies are way too reliant on the vendor and they shouldn't be. I think they need to get skills in house, so build them up*."

#### 2) BI tools, infrastructure and standardisation

PE explains that "*while the tools are very important, what's more important is how you utilise and implement the tools*". Self-service varied across the organisations, being seen as a promoter of pervasive BI by some, and a deterrent by others. Performance has a big influence on perceived user experience and is highly dependent on infrastructure capacity and network bandwidth (especially in country areas). Standardising on a single vendor's BI tool was not considered to be a big driving factor in whether business users made use of BI. Cost appears to be the biggest factor driving BI tool standardisation.

#### 3) Technology Cost

Participants reported that companies were always searching for the cheapest solution to make information available. Four organisations had an enterprise licence agreement in place with their respective vendors. Cost appears to be a bigger obstacle in smaller organisations.

#### 4) Regulatory compliance

While regulatory compliance had not been a major influence on the pervasiveness of their BI, participants noted that it was now playing more of a role in BI programmes, and would be a future influencer of pervasiveness.

## V. DISCUSSION OF FINDINGS

Based on the earlier definition of pervasiveness, it appears that the participating organisations are relatively successful. This section discusses the factors influencing (impeding or promoting) pervasive BI that emerged from the study, in context of the TOE framework [20].

Table II shows the factors influencing pervasive BI that emerged from the study, summarized in terms of the three aspects of the TOE framework. Most are positively related to pervasiveness, and all but technology cost, vendor relationship, and regulatory compliance are "internal".

TABLE II. FACTORS INFLUENCING PERVASIVE BI BY TOE

| Diffusion Factors | |
|---|---|
| **Technology** | - Technology Cost |
| | + Infrastructure capacity |
| | + Use of BI Tools |
| **Organisation** | + Perceived value |
| | + Executive buy-in & involvement |
| | + Strong business focus & ownership |
| | + Education & support |
| | + Incremental, phased approach |
| | + Information quality, form & availability |
| **Environment** | + Vendor relationship & support |
| | + Regulatory Compliance |

### A. Technology Context

The three diffusion factors listed under the technology context influence the extent to which BI is used across the organisation, and the diffusion of self-service capabilities. The strongest (negative) diffusion factor emerging in this context was the licence cost of BI tools. Most organisations had enterprise licences, which helped to mitigate this. All participating organisations were large, which made acquiring an enterprise licence feasible.

Slow performance impacts negatively on user experience, discouraging future use. Organisations have to plan ahead to ensure their infrastructure can cope with increased demand as BI becomes more pervasive in the organisation [7]. Most challenges experienced were due to network bandwidth limitations, particularly affecting self-service capabilities.

Organisations all invested in BI tools from leading vendors, including IBM Cognos, Business Objects, Qlikview, SAS and SPSS. They all attempted to standardise the tool sets used, but this was not considered to be critical to the pervasive use of BI. This is in contrast to literature that places a strong focus on BI tool standardisation [7].

### B. Organisation Context

Several diffusion factors relating to the organisation context emerged. A recurring theme is the importance of BI's perceived value to the organisation. The strongest factor, described as critical, is the importance of executive buy-in and sponsorship to an organisation's BI programme. Establishing business ownership was another strong organisational factor. All participants reported that organisations need to involve business as much as possible and make sure their needs are addressed; thereby ensuring BI is delivering value. These factors are consistent with key success factors reported in the literature [2][7][9], and were significant influencers driving alignment between the BI strategy and the corporate strategy.

Ongoing education, communication and support were considered to be essential in helping business users get most value from the information provided by the BI tools. Business users empowered with the right information to manage their business will ultimately make better decisions [14][15]. This will further encourage their use of BI and lead to a culture of fact-based decision making.

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Participants strongly recommended a phased, incremental approach that continuously delivers value to the organisation. Organisations should focus on areas of maximum impact, with each subsequent phase driven by a strategic business objective. This correlates with the literature [2].

All participants rated data quality of critical importance to ensure adoption and continued usage. Good data governance and the implementation of a single, trusted data repository are recommended [2][9]. In all instances a data warehouse was the source system for the BI implementation and was believed to be a cornerstone of the BI solution.

### C. Environment Context

Participants reported that regulatory compliance is starting to play more of a role in their BI programme. A factor that emerged in this context was the importance of having a strategic, long-term relationship with the vendor. Both vendor relationship and regulatory compliance are potential future influencers in the degree of BI use.

## VI. Conclusion and Future Work

Pervasive BI is achieved when BI forms an integral part of the decision making activities that occur within the business. BI is used in various ways in different organisations, and what one organisation might consider being pervasive BI might vary significantly from the next organisation's definition of pervasive BI.

It appears that the participating organisations rely heavily on BI in their decision making activities and continuously attempt to encourage a culture of fact-based decision making. These organisations align their BI strategy with their organisation's strategic goals, and BI receives strong support and buy-in from top management and the business areas for the value it generates. Ongoing education, communication and support, quality information and an incremental approach were also important in facilitating the pervasive use of BI within the organisations.

The T, O and E factors that influence pervasive BI were also researched as part of this study. The findings showed that the "O" context was the strongest influencer of BI pervasiveness in these organisations, as opposed to Technology, and the "E" context the least. It is hoped that this study will provide researchers and BI practitioners alike with some new perspectives into factors that promote pervasive use of BI; and also provide better insight into optimal use of their BI investment, facilitation of fact-based decision making, and improved performance for the organisation. Future research may look at how this develops in the light of the opportunities and hype of Big Data.

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